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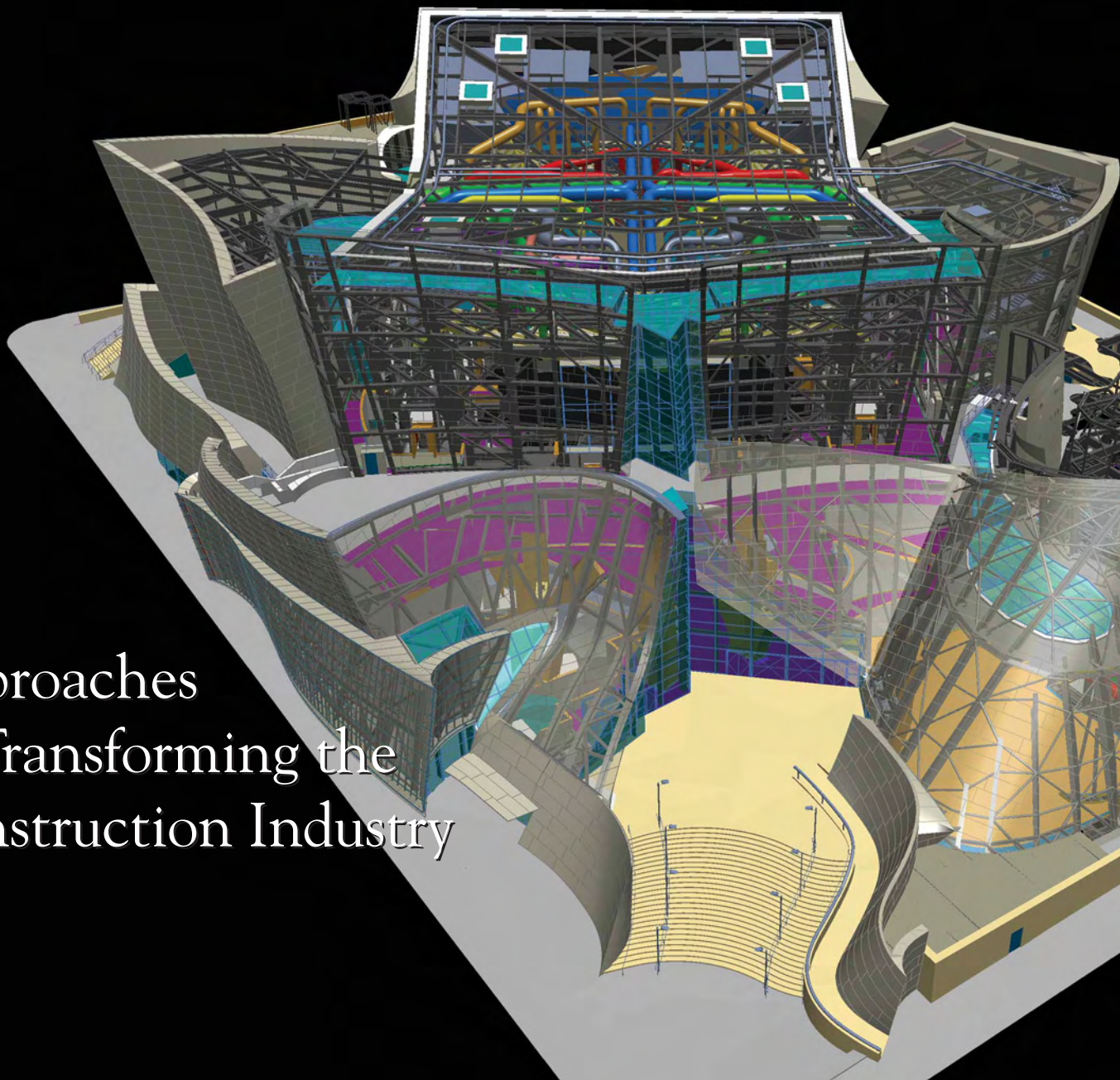

Approaches to Transforming the Construction Industry

Convergence and Standards

How the domains of architecture, engineering, construction, building owners and operators (AECOO) and geospatial technology are uniting to improve decision-making for facilities managers and the urban enterprise

By Mark Reichardt, President, Open Geospatial Consortium, Inc.

INTRODUCTION

Traditionally, architecture/engineering/construction (AEC) and GIS users created digital data for specific projects or business objectives. Quite often, there was no commitment to effectively sharing these data between the two domains. More recently, many business drivers, including cost reduction, have created an awareness in both domains that the data's value extends well beyond its original purpose. For almost any building or geospatial data, there are many likely or possible future uses as well as possible immediate secondary uses.

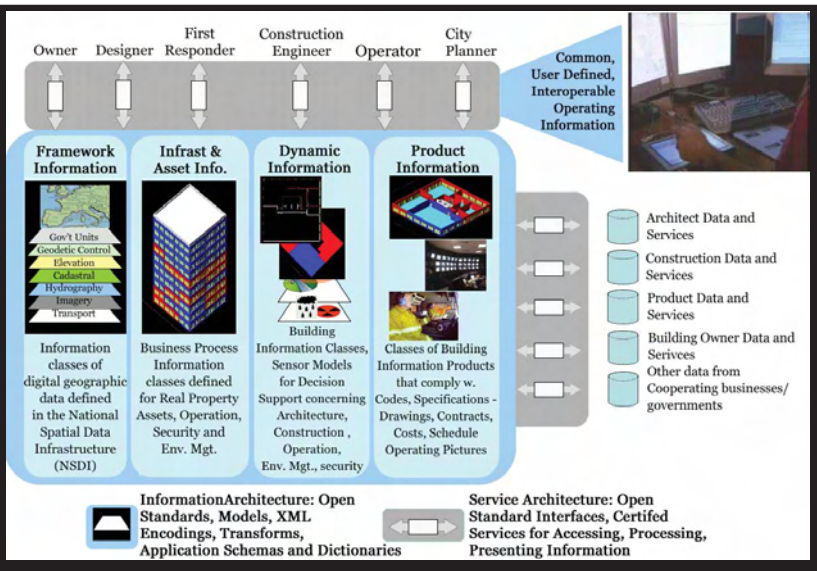

Figure 1 - NBIMS, OGC, buildingSMART alliance™, IAI and other organizations are working cooperatively to advance an environment where standards and best practices enable the management and exchange of BIM and geospatial information to meet an array of needs. (Figure copyright OGC).

Figure 2 - "Levels of Detail" (LoD) in CityGML. CityGML is an open data model and XML-based format for the storage and exchange of virtual 3D city models. It is an application schema for Geography Markup Language 3 (GML3), the extendible international standard for spatial data exchange issued by the OGC and ISO TC211. CityGML is an OGC Best Practice Paper.

The AEC industry has been making great strides in transitioning from the 2-dimensional paper world to the virtual world of Building Information Models (BIMs). In addition to supporting 3D and 4D visualization and analysis, BIMs enable easier management and exchange of detailed building information among multiple stakeholders throughout the life cycle of a building.

This article explores how cooperation between AEC and geospatial standards organizations is helping to advance the interoperability necessary to benefit those directly involved in the building lifecycle, as well as the first responders, urban planners, utility service providers, insurers, and others who support the broader urban environment.

THE NEED FOR CONVERGENCE

NIST (the National Institute of Standards and Technology) undertook a study in 2004 to estimate efficiency losses in U.S. commercial and institutional buildings and industrial facilities. NIST found that, in 2002, the annual cost associated with inadequate interoperability among computer-aided design, engineering and software systems was $15.8 billion.

More than half of this cost is borne by capital facilities owners and operators in the course of ongoing facility operation and maintenance. The information that facility managers need for routine and unexpected tasks is often not available and often needs, somehow, to be recreated.

Much of the information, of course, was originally available in documents created by the planners, architects and engineers who sited and designed the building and by the construction company and contractors who built the building. Some data was available from the engineers who did the mechanical

and electrical systems, site work, landscape design, and utility connections. Some data was obtained by design teams from manufacturers of building components. Some documents were filed by or with city agencies. Aerial imaging firms provided imagery. Documents were created as well by law firms, insurance firms, financial institutions, brokers and realtors who had business dealings with the building's designers, builders, owners, tenants and professional management firms.

Unfortunately, in most cases, most of these documents are difficult to find months or years after they were created. Not only are documents hard to find, but because data cannot be maintained and enriched through the building lifecycle, there is tremendous potential for error and cost overruns as the building lifecycle progresses.

Complicating this situation is the growing need to leverage both building and geospatial information to support and facilitate facilities, neighborhood and broader urban planning requirements; improve delivery of services; assure adequate safety and security procedures; and meet an array of other needs that rely on the integration of AEC and geospatial information. Convergence is necessary to analyze, model, understand and deal with very complex and critical issues. One example is analyzing pathways and timing of air flow through a subway system and into building infrastructure and other urban spaces for emergency preparedness. Another example is evaluating the costs and benefits associated with repurposing a building, considering all relevant factors, such as cost of changes to mechanical systems (plumbing, electrical, HVAC etc.); projections of revenue with or without renovations; occupancy history and alternative marketing scenarios; codes, permits and licensing; and transportation and parking.

PROGRESS TOWARD CONVERGENCE

The AECOO community is increasingly requesting provision of BIM information in their contracts to reap the benefits of improved quality and reduced life cycle costs related to business processes. So the time is now rapidly approaching when convergence of geospatial and building information can be achieved.

In fact, implementation of the concept has been ongoing. Most of the design software companies began years ago, for example, to provide their customers with improved integration of CAD and geospatial technologies. This has taken time, because these two kinds of spatial technologies are very different at a basic level. But market acceptance of integrated design/geospatial suites has been strong, and the work done by these vendors has increased their customers' awareness of the value of BIM.

Progress has also been facilitated by the Web. Web based distributed computing based on Web services (online processing services) lends itself to solutions that involve integration of diverse kinds of information stored on and served by networked computer systems. The eXtensible Markup Language (XML) offers a standard way for data files and Web services to be "self-describing". This creates the potential for a Web-wide "card catalog" system for discovery of data and services through the publishing of metadata (data about the data) in catalogs and directories. It also enables Web services to discover how the data needs to be processed. Indeed, the AECOO community has embraced key XML encodings to help automate information exchange, such as: Industry Foundation Classes (IFC), a data representation standard and file format for defining architectural and constructional CAD graphic data as 3D real-world objects; AGCxml, an XML schema for electronic interchange of common construction data and documents; and aecXML, a data representation standard designed for all the non-graphic data involved in the construction industries. However, harmonization of these, and additional web services interfaces, defined as open standards, will be necessary to move BIM lifecycle management to a truly automated process.

It is worth noting that geospatial processing services have been some of the first capabilities to make the transition to Web services. This proves that Web services can serve complex application domains if a critical mass of industry stakeholders work together in an open and formal standards process such as that provided by the Open Geospatial Consortium, Inc. (OGC).

The Web favors standards because, in general, the value of a data set or service increases with the number of users who can use it, and free and open standards tend to increase the number of users. So the Web is based largely on free and open standards developed by a variety of consensus standards

organizations, such as the W3C (World Wide Web Consortium), OASIS (Organization for the Advancement of Structured Information Standards), the Web3d Consortium, and the OGC.

To facilitate lifecycle building process integration and sharing of digital datasets, the National Institute of Building Sciences formed a committee in early 2006 to create a National Building Information Model Standard (NBIMS) to provide a common model for describing facility information exchanges. The committee is comprised of a carefully selected group of leaders representing the full spectrum of AECOO stakeholders. Work programs were planned, funding was obtained, and teams of developers have been making good progress toward completion of the standard.

In addition, the AIA is reviewing their contract documents to enable automated transfer of a BIM in which the BIM and the intellectual property it represents can flow from the architect to the owner and operator.

Other data creators are confronting requirements to do the same. Government agencies such as the U.S. General Services Administration (GSA) now require delivery of spatial program information from BIMs for major projects that are receiving design funding in Fiscal Year 2007 and beyond. The Government's requirements tend to make sense to private sector owners and operators, so data creators are gearing up to fit BIM into their business processes. Some observers anticipate the emergence of a new group of companies whose main work will be BIM management.

The AECOO community is making great strides. NBIMS is defining data exchanges around the building lifecycle. Other standards efforts are developing XML encodings to deal with various aspects of data exchange, such as the IFC, AGCxml, and aecXML encodings noted above, and CityGML shown in **Figure 2**.

But in order for all of this to work fluidly in an automated fashion, the stakeholder industries need a common Web services infrastructure. The OGC has already developed an open standards service oriented architecture (SOA) framework and has also developed collaborative partnerships with the buildingSMART alliance™, IAI chapters and others to help advance the SOA framework. Additionally, OGC is organizing collaborative testbed activities that unite users and industry technology solution providers to validate BIM standards and develop and promote related standards that enable the convergence of AEC and geospatial information. Security and rights management are among the requirements set forth in testbed scenarios.

The ability to improve quality and reduce cost over the lifecycle of a building is a major value point for standards-based BIM. The value proposition is further expanded if one also takes into account the potential for the convergence of BIM and geospatial information to improve decision making related to broader community and urban planning and problem solving. These cumulative social benefits make the case for standards based BIM/geospatial convergence incontrovertible. ■

Mark Reichardt is President of the Open Geospatial Consortium, Inc. He works with the building standards community to advance seamless integration of geospatial and BIM information to address critical urban planning, safety, security and operations requirements.